system the opposed propositions, which do show their subject to be unreasonable, are intended to do duty as contradictories. But in Kant's system the opposed propositions in an antinomy are only seeming contradictories, are virtually contraries, and their common subject remains the subject of an intelligible proposition, and one that Kant believes himself to have substantiated, after the contraries are invalidated: so that the subject is after all amenable to the processes of human thought, though not representing an object of experience. I dare not further trespass on the columns of Nature to comment upon Prof. Clifford's views of the two legs of Kant's philosophy! Certainly the one leg is wholly due to my opponent's "exuberant imagination:" it is Hamilton's leg, not Kant's.

Athenæum Club, Feb. 17 C. M. Ingleby

Inherited Feeling

The remarkable case of an inherited feeling of dislike for a special class of persons, communicated by Mr. Darwin, appears to me to support a view I have long held (but not yet published) as to the explanation of another class of so-called instincts. The three separate instances given in which the dogs showed a violent antipathy to butchers, either without seeing them or when they were dressed as gentlemen, clearly indicates that it was through the sense of smell that the painful sensation was experienced; and this is quite in accordance with the wonderful delicacy and importance of this sense in most animals, and especially in dogs. It is natural to suppose that some ancestor of these dogs was systematically and cruelly ill-treated by several butchers, perhaps from some thievish propensity or other bad habit which required frequent punishment, so that the smell of a butcher came to be invariably associated with pain and a desire for revenge. But the most important fact to observe is, that there must be some peculiar odour developed in human beings by constant contact with flesh, which a dog can recognise apart from individual peculiarities and in spite of perfect disguise. Now the power many animals possess to find their way back over a road they have travelled blindfolded (shut up in a basket inside a coach for example) has generally been considered to be an undoubted case of true instinct. But it seems to me that an animal so circumstanced will have its attention necessarily active, owing to its desire to get out of its confinement, and that by means of its most acute and only available sense it will take note of the successive odours of the way, which will leave on its mind a series of images as distinct and prominent as those we should receive by the sense of sight. The recurrence of these odours in their proper inverse order—every house, ditch, field, and village having its own well-marked individuality—would make it an easy matter for the animal in question to follow the identical route back, however many turnings and cross-roads it may have followed. This explanation appears to me to cover almost all the well-authenticated cases of this kind.

Alfred R. Wallace

I am able to corroborate the remarkable fact mentioned in Dr. Huggins's letter in your last.

My father possessed a mastiff, a son of Sybil, daughter of Turk, who has, ever since he was a pup, evinced the same antipathy to butchers. We have hitherto been unable to explain it, for he is always perfectly good tempered with other tradesmen who come to the house. The butchers have, on several occasions, tried to propitiate him by throwing him presents of meat, but although willingly enough received, it has done nothing towards abating his hostility. H. G. Brooke

Hale Carr, Altrincham, Feb. 15

I have a cat, of a long-haired breed, whose aversion to dogs is unusually strong. Last autumn, six kittens of hers, under two days old, were in a corner of the kitchen where they had had no opportunity of making acquaintance with any dog; yet, on being stroked (in their mother's absence) by a hand which a dog had just licked, more than one of them "swore" violently. This was repeated several times, but the little creatures showed no dislike to being touched with a clean hand.

A Lover of Animals

Two or three months ago I was walking with my two little girls near the railway bridge at West Kensington, when the children (who always find the attraction of a fine dog irresistible) made me stop to admire a tall and remarkably handsome mastiff, apparently the property of a man who stood by with a handbarrow. He was speaking to two other men of this dog, and of another of the same kind which he had at home, and telling them that they were quiet and amiable to all men but butchers, and that it was not safe for a butcher to come near either of them. One of the men said that he believed all dogs of that breed showed the same antipathy; and added that when they were left loose at night to guard premises, they would always allow a policeman to enter.

This chance conversation is perhaps hardly worth troubling you with, as I have no means of ascertaining whether these dogs claimed kindred with Turk, but I send it to you, nevertheless.

M.

Kensington Square, Feb. 17

EFFECT OF LIGHT ON SELENIUM DURING THE PASSAGE OF AN ELECTRIC CURRENT.*

Being desirous of obtaining a more suitable high resistance for use at the Shore Station in connection with my system of testing and signalling during the submersion of long submarine cables, I was induced to experiment with bars of selenium, a known metal of very high resistance. I obtained several bars varying in length from 5 to 10 centimetres, and of a diameter from 1 to 1½ millimetres. Each bar was hermetically sealed in a glass tube, and a platinum wire projected from each end for the purpose of connection.

The early experiments did not place the selenium in a very favourable light for the purpose required, for although the resistance was all that could be desired—some of the bars giving 1,400 megs. absolute—yet there was a great discrepancy in the tests, and seldom did different operators obtain the same result. While investigating the cause of such great differences in the resistance of the bars, it was found that the resistance altered materially according to the intensity of light to which it was subjected. When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest, and remained very constant, fulfilling all the conditions necessary to my requirements; but immediately the cover of the box was removed, the conductivity increased from 15 to 100 per cent. according to the intensity of the light falling on the bar. Merely intercepting the light by passing the hand before an ordinary gas-burner placed several feet from the bar increased the resistance from 15 to 20 per cent. If the light be intercepted by rock salt or by glass of various colours, the resistance varies according to the amount of light passing through the glass.

To ensure that temperature was in no way affecting the experiments, one of the bars was placed in a trough of water so that there was about an inch of water for the light to pass through, but the results were the same; and when a strong light from the ignition of a narrow band of magnesium was held about nine inches above the water the resistance immediately fell more than two-thirds, returning to its normal condition immediately the light was extinguished.

PARTING BANQUET TO PROF. TYNDALL

On the evening of February 4 Prof. Tyndall's visit to the United States was crowned by a banquet at Delmonico's, New York, at which there were present about 200 of the most distinguished citizens of the country, presided over by the Hon. William M. Evarts. Among the company present were the following:—The Rev. Dr. Bellows, Parke Godwin, Dr. Draper, A. M.

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* Communicated to the Society of Telegraph Engineers, February 12, by Mr. Latimer Clark, from Mr. Willoughby Smith, Electrician to the Telegraph Construction Company.

Mayer, Rev. Henry Ward Beecher, President F. A. P. Barnard, Rev. Dr. Hitchcock, Rev. Dr. H. C. Potter, Dr. A. Flint, Dr. Hammond, Rev. Dr. Osgood, A. Appleton, G. S. Appleton, Judge Brady, Dr. H. Draper, V. Botta, J. C. Draper, Judge Daly, the Hon. E. D. Morgan, B. Silliman, Prof. G. F. Barker, of Yale College, Gen. Franklin, D. Van Nostrand, H. S. Kendrick, Prof. Chandler, Prof. S. F. Baird, of the Smithsonian Institute, Prof Michie, Prof. Pompelly, E. L. Godkin, Fred. Law Olmsted, Prof. W. H. Chandler, of Columbia College, Sterry Hunt, C. W. Field, Gen. Myers, E. L. Youmans, A. S. Hewitt, Wilson G. Hunt, Dr. Sims, Col. Dwight, J. B. Scribner, W. H. Appleton.

There were several very happy after-dinner speeches, by men of various professions and opinions. We present our readers with a few extracts from the speech of Prof. Tyndall.

Referring to the interest shown in his lectures, he said:—"Every such display of public sympathy must have its prelude, during which men's minds are prepared, a desire for knowledge created, an intelligent curiosity aroused. Then in the nick of time comes a person who, though but an accident, touches a spring which permits tendency to flow into fact, and public feeling to pass from the potential to the actual. The interest displayed has really been the work of years, and the chief merit rests with those who were wise enough to discern that, as regards physics, the detent might be removed, and the public sympathy for that department of science permitted to show itself. Among the foremost of those who saw this must be reckoned my indefatigable friend Prof. Youmans. In no other way can I account for my four months' experience in the United States. . . To no other country is the cultivation of science in its highest forms of more importance than to yours. In no other country would it exert a more benign and elevating influence. What, then, is to be done toward so desirable a consummation? Here I think you must take counsel of your leading scientific men, and they are not unlikely to recommend something of this kind. I think, as regards physical science, they are likely to assure you that it is not what I may call the statical element of buildings that you require so much as the dynamical element of brains. Making use as far as possible of existing institutions, let chairs be founded, sufficiently but not luxuriously endowed, which shall have original research for their main object and ambition. With such vital centres among you, all your establishments of education would feel their influence; without such centres even your primary instruction will never flourish as it ought. I would not, as a general rule, wholly sever tuition from investigation, but, as in the institution to which I belong, the one ought to be made subservient to the other. The Royal Institution gives lectures—indeed it lives in part by lectures, though mainly by the contributions of its members, and the bequests of its friends. But the main feature of its existence—a feature never lost sight of by its wise and honourable Board of Managers—is that it is a school of research and discovery. And though a bylaw gives them the power to do so, for the twenty years during which I have been there no manager or member of the institution has ever interfered with my researches. It is this wise freedom, accompanied by a never-failing sympathy, extended to the great men who preceded me, that has given to the Royal Institution its imperishable renown.

"I have said that I could not wholly sever tuition from investigation, and I should like to add one word to this remark. In your chairs of investigation let such work as that in which I have been lately engaged be reduced to a minimum. Look jealously upon the man who is fond of wandering from his true vocation to appear on public platforms. The practice is absolutely destructive of original work of a high order. Now and then the discoverer, when he has anything important to tell, may appear with benefit to himself and the world. But as a general rule he must leave the work of public lecturing to others. This may appear to you a poor return for the plaudits with which my own efforts have been received; but these efforts had a special aim. My first duty toward you, moreover, is to be true, and what I say here is the inexorable truth.

"As to the source of the funds necessary for founding the chairs to which I have referred it is not for me to offer an opinion. Without raising the disputed question of State aid, in this country it is possible to do a great deal without it. As I said in my lectures, the willingness of American citizens to throw their fortunes into the cause of public education is without a parallel in my experience. Hitherto their efforts have been directed to the practical side of science, and this is why I sought in my lectures to show the dependence of practice upon principles. On the ground, then, of mere practical, material utility, pure science ought to be cultivated. But assuredly among your men of wealth there are those willing to listen to an appeal on higher grounds, to whom, as American citizens, it will be a pride to fashion American men so as to enable them to take their places among those great ones mentioned in my lectures. Into this plea I would pour all my strength. Not as a servant of Mammon do I ask you to take science to your hearts, but as the strengthener and enlightener of the mind of man.

"Might I now address a word or two to those who in the ardour of youth feel themselves drawn toward science as a vocation. They must, if possible, increase their fidelity to original research, prizing far more than the possession of wealth an honourable standing in science. They must, I think, be prepared at times to suffer a little for the sake of scientific righteousness, not refusing, should occasion demand it, to live low and lie hard to achieve the object of their lives. I do not here urge anything upon others that I should have been unwilling to do myself when young. Let me give you a line of personal history. In 1848, wishing to improve myself in science, I went to the University of Marburg—the same old town in which my great namesake, when even poorer than myself, published his translation of the Bible. I lodged in the plainest manner, in a street which, perhaps, bore an appropriate name while I dwelt upon it. It was called the *Ketzerbach*—the heretic's brook—from a little historic rivulet running through it. I wished to keep myself clean and hardy; so I purchased a cask and had it cut in two by a carpenter. Half that cask, filled with spring water over night, was placed in my small bedroom, and never during the years that I spent there, in winter or in summer, did the clock of the beautiful Elizabethekirche, which was close at hand, finish striking the hour of six in the morning before I was in my tub. For a good portion of the time I rose an hour and a half earlier than this, working by lamp-light at the differential calculus when the world was slumbering round me. And I risked this breach in my pursuits and this expenditure of time and money, not because I had any definite prospect of material profit in view, but because I thought the cultivation of the intellect important—because, moreover, I loved my work, and entertained the sure and certain hope that, armed with knowledge, one can successfully fight one's way through the world. It is with the view of giving others the chance that I then enjoyed that I propose to devote the surplus of the money which you have so generously poured in upon me, to the education of young philosophers in Germany. I ought not, for their sake, to omit one additional motive by which I was upheld at the time here referred to—that was a sense of duty. Every young man of high aims must, I think, have a spice of this principle within him. There are sure to be hours in his life when his outlook will be dark, his work difficult, and his intellectual future uncertain. Over such periods, when the stimulus of success is absent, he must be carried by his sense of duty. It may not be so quick an incentive as glory, but it is a nobler one, and gives a tone to character which glory cannot impart. That unflinching devotion to work, without which no real eminence in science is now attainable, implies the writing at certain times of the stern resolve upon the student's character: 'I work not because I like to work, but because I ought to work.' In science, however, love and duty are sure to be rendered identical in the end."

*THE TROGLODYTES OF THE VEZERE**

I HAVE come to speak to you about the Troglodytes of the Vezère, of that fossil population whose subterranean dwellings we are about to visit.

Their existence dates back to a startling antiquity. We do not know their name; no historian has mentioned them, not a vestige of them had been discovered until the last eight years; and yet they are better known to us, in many respects, than certain nations celebrated in classical history. We know their mode of life, their industry, their arts, and all the details of their existence. Is not this the true history of races, a history far more interesting than that of their battles, their conquests, and even their dynasties? How can we know so much of a people who have left no trace in the memory of man, and whose very existence would have been declared impossible twenty years ago? Are they the creatures of a dream, like the celebrated Troglodytes of Montesquieu? No. Nothing is more real than our Troglodytes; nothing more authentic than their annals. In the caverns which they inhabited, in those in which they laid their dead, have been found fragments of their meals, productions of their industry and arts, and remains of their bones. It is in this book that their history has been read; it is with these documents that their past existence has been resuscitated.

Many *savants* have taken part in these researches. Among others, Christy, the Marquis de Vibraye, M. Falconer, and our two colleagues, MM. Louis Lartet and Elie Massénat, deserve honourable mention; but there is one name that eclipses all the others, it is that of the founder of human palæontology—Edward Lartet.

I.—*Determining the Epoch*

Before speaking about a people it is well to assign it a place in time. But in this instance ordinary chronology is inapplicable. We are touching on periods of an incalculable length. Since the epoch when our Troglodytes lived, the climate and fauna have undergone considerable modifications, which have been produced slowly, without any revolution, without violent action, under the influence of those imperceptible causes which are still at work in our own day; and when we consider that, during the course of centuries of known time, these causes have only produced scarcely appreciable changes in our surroundings, we can have some idea of the prodigious duration of what is styled a geological epoch. These immense periods can neither be measured by years, by centuries, nor by thousands of years; these dates cannot be expressed in numbers, but we can determine the order in which the geological epochs followed each other, and the periods of which each is composed. These are the dates of the history of our planet; and the elements of what Edward Lartet has designated *palæontological chronology*. It will suffice for us to determine our dates from the commencement of the *quaternary epoch.*

The end of the tertiary epoch had been signalised by a remarkable phenomenon, of which the cause is not yet perfectly known. The northern hemisphere had gradually become colder. Immense blocks of ice, descending from the sides of the mountains into the valleys and plains, had covered a considerable portion of Europe, Asia, and North America; and the temperature of our zone, till then torrid, had by degrees become frigid. The duration of this cold period, called the *glacial period*, was excessively long. After having attained their farthest limits, the glaciers retired considerably, then they advanced again, but without regaining their former position. This was the last phase of the tertiary epoch. The glacial period was nearly at an end. A gradual modification of temperature caused the melting of the ice, and the quaternary epoch commenced. The glaciers, those immense masses of snow, hardened by time and accumulated during thousands of ages, produced, when they melted, gigantic torrents, sweeping along in their powerful waves the ruins of mountains, flooding the plains, ploughing up the soil, hollowing the valleys and leaving in their track large deposits of sand, pebbles, and argile. From that epoch, called the *diluvian*, are dated our present rivers, but they give us in these days but a faint idea of what they were then.

The extraordinary power of the water floods was above all remarkable during the early part of the quaternary epoch; it gradually decreased from that time, but it was not until the glaciers had retired within their original bounds, until the temperature had become nearly equal to that of our own day, that the phenomenon of the great inundations ceased, and that the quaternary epoch drew to a close. Since that time, we still find sand and pebbles displaced, and sometimes even masses of more or less volume torn from the sides of the valleys by the torrents, but the rivers and streams no longer bear along with them more than particles of clay and slime, and these deposits have formed alluvial soil. The whole period which has elapsed since the close of the quaternary epoch bears the name of *present epoch*, and the soil which has been formed in this period is called *recent soil.* It is, certainly, recent, if we compare it with the quaternary soil, but not with reference to our ordinary chronology, for several hundreds of ages must necessarily have elapsed during its formation.

These considerations will aid us in comprehending the most essential facts which have served to establish the dates of human palæontology. These dates are determined in the first place by pure geology, in the second by palæontology, and in the third by prehistoric archæology.

The geological dates are chiefly inscribed in the valleys and in the plains, where the great floods of the quaternary epoch have left deposits in the shape of layers more or less regularly stratified. Except where some event has disturbed or excavated the soil, the layers are superposed in order of antiquity. The oldest are found beneath and are called low level; above them are ranged the middle level, which succeed them, and which are, in their turn, covered by the layers of the upper level, dating from the latter part of the quaternary epoch. We find a layer more or less thick of recent soil, formed of accretions, turf, vegetable matter, &c., covering almost all the quaternary soil.

It must suffice to explain in a general way how the study of the stratification of the layers, termed stratigraphy, enables us to determine the relative age of the recent or quaternary deposits. This primary classification is purely geological. Thanks to the data which it furnishes, we can calculate the period of existence of those animals whose bones are found in the different layers; these animals in their turn serve to characterise periods, and can thus establish the dates of certain soils, or of those partial deposits which do not form a part of a complete and regular stratification.

1. Among the animals living in our land at the beginning of the quaternary epoch, some, like the mammoth, no longer exist save in a fossil state; these are the extinct animals; others, like the reindeer, have disappeared from our climate, but still live in other regions; these are the

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* Being the substance of the Address of M. Paul Broca to the French Association for the Advancement of Science, at the Session held at Bordeaux.